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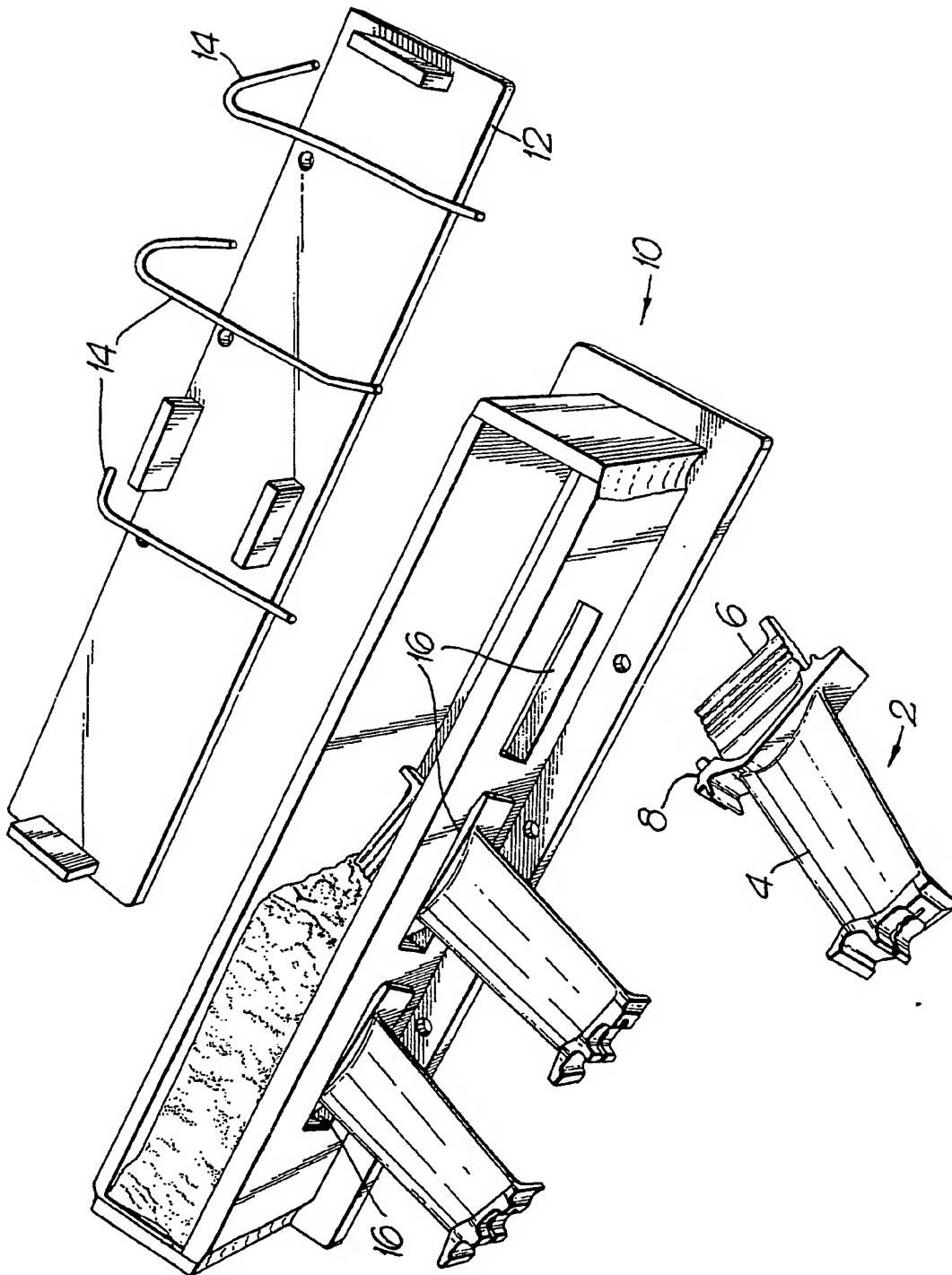
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(54) **Selective chemical vapour deposition**

(57) A fine powder capable of absorbing the coating vapour in a chemical vapour deposition process is packed around those parts of components it is wished not to coat. The particular example described involves aluminising only the aerofoil section of a gas turbine blade. Thus, the firtree root section is enclosed within a nickel alloy box and packed around with a fine powder. The powder may comprise an active constituent eg. nickel and a refractory filler material eg. alumina.



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## CHEMICAL VAPOUR DEPOSITION

The invention relates to a chemical vapour deposition process of the type used particularly, but not exclusively for depositing an aluminide layer on the surface of gas turbine blades and other engine components.

In a process of the type referred to, it is usual where the size of the components permit to treat a plurality of them simultaneously. The components are placed in a retort together with a quantity of aluminising powder and then heated in a low pressure inert atmosphere. A typical aluminising powder consists of aluminium powder, aluminium fluoride and a relatively inert refractory material like alumina (aluminium oxide). After the retort is sealed the air is pumped out of it and maintained at a constant pressure with inert gas such as argon.

In the case of gas turbine blades, the surface of certain parts of the components is not to be aluminised, the surface of the fir-tree root portions for example. Accordingly these parts are normally masked by covering them in a masking slurry or paste. These techniques have certain disadvantages and neither is particularly suitable for use in production quantities. The slurry technique is slow because it requires the application of a number of coats, and still the results can be inconsistent. The dried slurry coats also have to be removed later using a high pressure water jet.

The present invention has for its object to provide a quicker, cheaper and more reliable method of masking against surface deposition in a chemical vapour deposition process.

According to the present invention a chemical vapour deposition process for coating part only of an object includes protecting a portion of the object not to be coated from the effects of the vapour by enclosure together with a closely packed powder which is capable of absorbing the vaporised material.

Preferably the portion to be protected is enclosed within a box-like structure constructed of nickel alloy and is surrounded by a protective powder comprising a mixture of an active component, such as nickel alloy, which absorbs the vapour either with or without a relatively inert powdered or granulated refractory filler, such as alumina.

The invention and how it may be carried into practice will now be described in greater detail with particular reference, by way of example only, to the accompanying illustration of a masking box for mounting gas turbine blades.

There is shown in the accompanying drawing at 2 a turbine blade for the turbine stage of an aeroengine. This blade 2 has an aerofoil section 4, a firtree root 6 and between these a platform section 8. A gas turbine rotor comprises a multiplicity of such blades mounted in an annular assembly with platforms 8 abutting and the aerofoil sections 4 projecting radially outwards

into the engine gas path. The roots 6 of these blades are clamped in a disc mounting assembly.

The turbine rotor blades are generally manufactured from special alloys by crystal growth, casting or forging. In order to improve the resistance of the basic alloy to corrosion by hot turbine gases it is usual to provide the exposed sections of the blades with an aluminised layer. However, the whole of a blade is not covered in this protective layer because penetration of aluminium into the surface of the blade modifies the material properties of the alloy to some degree, for example its resistance to fatigue is reduced and the dimensions change. For these reasons it is undesirable to treat the root section and accordingly those parts of a blade are masked against the aluminising vapour.

It is preferred to use a low pressure, aluminising process, of the type described above, in which blades are exposed to an aluminising vapour produced in a sealed retort by heating an open tray of aluminising powder to its operating temperature (about  $950^{\circ}\text{C}$ ) in the presence of an inert atmosphere. In order to protect the root sections 6 of the blades 2 from the vapour the blades are mounted in a box like structure generally indicated at reference 10.

The box 10 is constructed of 10 swg nickel alloy sheets welded together to form a hollow rectangular container open on one side. A removable lid 12 is provided to close the open side of box 10, and this may be held in place by a

plurality of wire clips such as 14. At least one of the long side faces of the rectangular box 10 is pierced by several apertures 16 into each of which a blade 2 may be mounted. The apertures 16 conform closely to the plan view of the blade platform 8 and are formed so as to positively engage the blade platform whereby to locate the blades with respect to the box 10.

Having mounted a blade in each of the apertures provided in a box it is then filled with a fine masking powder. A grain size of the order of 200 mesh is found satisfactory. The box may be shaken, by means of a mechanical vibrator, to compact the powder closely around the blade roots ensuring that all pockets are filled. After this the lid 12 is secured in position, using clips 14 or any other convenient method of attachment, and the assembly suspended in the aluminising retort.

A variety of powder compositions may be used with generally acceptable masking properties although some may be preferred to others because of their secondary characteristics. For example, a mixture of 50 parts nickel powder similar to that used, with 50 parts alumina powder by weight is found to perform well and to be reusable to a limited extent. Alternatively, good results are obtained by using powdered alloy of the same composition as that used to manufacture the turbine blades themselves. Alloy powder of the same mesh size as before is loaded into the masking box in the same way as previously described.

## CLAIMS

1. A chemical vapour deposition process for coating part only of an object includes protecting a portion of the object not to be coated from the effects of the vapour by enclosure together with a closely packed powder which is capable of absorbing the vaporised material.
2. A process according to claim 1 wherein the vaporised material consists of aluminium.
3. A process according to claim 1 or claim 2 wherein a box like structure for enclosing the portions of the object to be protected and the protective powder is constructed substantially of nickel.
4. A process according to claim 3 wherein the box like structure has a face in which there is formed an aperture for receiving the object, the aperture being formed so as to engage closely with the object in a position whereby the portion not to be coated lies wholly within the enclosure.
5. A process according to claim 4 wherein a box like structure adapted to protect part of a gas turbine engine blade has an aperture formed to engage a root shank portion of the blade so that the root of the blade lies wholly within the enclosure.

6. A process according to any preceding claim wherein the powder comprises a mixture of a powdered active component which is effective to absorb the vaporised material and a relatively inert powdered or granulated refractory filler.

7. A process according to claim 6 wherein the composition of the masking powder includes nickel as the active component.

8. A process according to claim 6 or claim 7 wherein the composition of the powder includes at least 20% refractory filler.

9. A process according to any of claim 1-5 wherein the protective powder consists of the same material from which the component is manufactured.

10. A process substantially as described with reference to the accompanying drawing.